FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 77 Thursday, December 13, 1945 No. 1530

"First Things First"

The motto "First Things First" was much in evidence during the war, and the carrying out of its implications was a major factor in the organisation which ensured a victorious conclusion. Unfortunately, there does not seem to be the same clear thinking operating for the rehabilitation of the country. Rightly, the Government has accorded priority to rehousing and the export trade. Yet the public has still to learn that the spirit of reconversion depends absolutely and fundamentally on the provision of man-power for the foundry industry. Recently we visited a small exhibition organised by the Ministry of Fuel and Power at the Army and Navy Stores in London. It was designed to emphasise to the man in the street the need to conserve all forms of fuel. This was done by means of a dozen or so models which showed what should be obvious to everybody—that coal was essential to the economical life of this country. It implied that neither could houses be built or export goods manufactured without the expenditure of fuel—a material in short supply. What it failed to show was that a major factor in the production of coal was machinery or, in other words, aggregations of castings.

We are satisfied that the Minister of Labour and National Service well appreciates that the dearth of man-power in the foundry industry is the major bottleneck. But he needs support, and this can only be fully accorded to him when the whole nation appreciates the situation. In the United States, parallel conditions exist, but there in Senator the Hon. Alexander Wiley, the grey-iron foundry industry has found a worthy protagonist. Before addressing the Senate he wrote the following letter to the Hon. John R. Snyder, the Director of the Office of War Mobilisation and Reconstruction:—

"Dear Mr. Snyder,—There has recently been called to my attention a very serious situation in the grey-iron founders' industry. As you know, we have a number of grey-iron founders in Wisconsin. I am informed that, if this situation is cleared up—if 68,000 to 70,000 men can be secured for this industry—it will mean that, as a result of what they produce, jobs for three or more million men in industries which use the grey-iron castings will be created. I will be specific in this matter. The automobile industry, as you know, is in dire need of grey-iron castings for motor blocks and heads. The refrigeration and air-conditioning industries require castings for motor compressors and heads, motor endframes, cylinders, and rings; the washing machine industry for frames, arms, motor endframes; the textile industry for repair parts for looms, weaving machines; and all types of textile machinery; the rubber industry for tyre moulds and repair parts for the rubber-making machinery; the mining industry for coal-mining machinery; the railroads for brake shoes and car wheels. Other industries need these vital items for farm machinery; for food processing machinery; for office equipment, etc.

"I have recently listened to talks over the radio and seen Press releases in relation to shortages, but all of these seem to have missed the vital point that none of these shortages can be met without the prior production of grey-iron castings. As you know, much of the machinery that we are relying upon for reconversion has been worn out and the need for new parts (castings) in all the lines suggested above is so critical that I feel that I am doing the proper thing in calling your attention to this fact, which you undoubtedly know, but because of pressure of business and other matters may have overlooked. Now, anyone who makes a suggestion should have a remedy. If the Government is really interested (as I think it is) in getting reconversion under full steam, then the Government must look after 'first things first.' That means getting 70,000 workers into the grey-iron founders' industry—70,000 jobs there are looking for men. What is the Government doing about filling those jobs? I am sure it is not disputed that these jobs will produce three million other jobs. Is there anything more important in America than the matter of creation of jobs—the very thing about which I am writing you? If there is, I don't know it. On other occasions the Government has taken steps to get men to fill

(*Continued overleaf, column* 2.)

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FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

DECEMBER 14.

Institute of Welding (Birmingham branch):—"Fabrication and Welding of Bridging Equipment," by R. G. Braithwaite. At the James Watt Memorial Institute, Great Charles Street, Birmingham, at 6.30 p.m.

Keighley Association of Engineers:—Films on Mulberry Harbour, Operation Pluto, Bailey Bridge, and Valley of the Tennessee. At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

Institution of Mechanical Engineers:—"Some Notes on the 'Merchant Navy' Class Locomotives of the Southern Railway," by O. V. S. Bulleid. At Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

Staffordshire Iron and Steel Institute:—Open discussion: "How Far Can Iron Castings Replace Steel?" At the Dudley and Staffordshire Technical College, The Broadway, Dudley, at 7 p.m.

DECEMBER 15.

Manchester Association of Engineers:—Conversazione and dance. At the College of Technology, Manchester.

DECEMBER 17.

Iron and Steel Institute:—Joint meeting with the Cleveland Institution of Engineers. "Some Design and Operating Features of a New Blooming Mill," by G. A. V. Russell and G. W. Fox. At the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 6.30 p.m.

Sheffield Society of Engineers and Metallurgists:—Annual general meeting. "Colour Television," by L. C. Jesty. At the Royal Victoria Station Hotel, Sheffield, at 6.15 p.m.

DECEMBER 18.

Institute of Welding (Liverpool branch):—"Metallurgy for Welders," by D. Llewellyn.

DECEMBER 19.

Institute of Welding (Wolverhampton branch):—"Fabrication Methods—Manipulators," by J. A. Dorrat. At the Victoria Hotel, Wolverhampton, at 7 p.m.

Institute of Welding (Sheffield branch):—"Gas Holders—Old and New," by H. Hollis. At the Royal Victoria Station Hotel, Sheffield, at 6.30 p.m.

DECEMBER 21.

Institution of Mechanical Engineers:—"The Awful Compromise," by Sir Claud D. Gibb. At Storey's Gate, St. James's, Park, London, S.W.1, at 5.30 p.m.

Institute of British Foundrymen

DECEMBER 15.

Bristol and West of England branch:—Visit to the works of the National Smelting Company, Limited, Avonmouth, at 10 a.m. "Pressure Die Casting," by G. T. Vicary. At the Merchant Venturers' Technical College, Bristol, at 7 p.m.

East Midlands branch:—"Some Principals of Production Control and Their Application to the Manufacture of Steel Castings," by A. B. Lloyd. At Loughborough College, at 6 p.m.

DECEMBER 21.

Falkirk section:—Short Papers. At the Temperance Café, Lint Riggs, Falkirk, at 7 p.m.

PUBLICATIONS RECEIVED

Lectures in Foundry Practice—Specimen Notes for Teachers. Edited by T. Makemson, and published for private circulation only by the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3.

The object of this book is to indicate to teachers the information they must possess to conduct classes which prepare students for the intermediate examination in foundry practice, organised by the City and Guilds of London Institute. Naturally here and there information is given, but generally the lecturer must build up either from practical experience or works of reference the subject matter of each lecture. The book, which is mimeographed on foolscap sheets, is conveniently divided into 18 numbered sections, each one having reference to a paragraph of the syllabus. The printed syllabus of the City and Guilds lists a number of standard text-books, and one outcome of the publication of these notes should be a knowledge as to whether these books are sufficiently comprehensive. Over a dozen high-grade technologists have contributed to the notes, and reducing these to a uniform type of presentation must have been a herculean task, and in this Mr. Makemson has been outstandingly successful.

Carron in Wartime. Published by the Carron Company, Carron, Falkirk.

This well-illustrated, 20-page brochure opens up with a reminder that since it was established in 1759 the company has harnessed its resources to the production of munitions of war whenever hostilities have commenced. Though the company, which is incorporated by Royal Charter, was making guns when Napoleon was in his cradle, and has made a notable contribution to every war fought since that time, it is most proud of the records made during the last six years. Every branch of the Services has been catered for, and *inter alia* a part of the light iron foundry was converted to the production of manganese steel tank tractor links. A major contribution was made to the well being of the troops and of the civilian population by the large scale production of canteen and kitchen equipment—a line of manufacture for which this company has a world-wide reputation. The Carron motto, "Esto Perpetua," after 186 years of continuous expansion, is entirely appropriate, and the reviewer congratulates the present management on the lustre they have added to their time-honoured escutcheon.

"First Things First"

(Continued from previous page.)

critical situations. I think that is what must be done now.

"Will you kindly let me hear from you in the immediate future in relation to what is intended to be done and what is done on this matter?—Yours, etc., Alexander Wiley."

We are in no position to query Mr. Wiley's figure of 3,000,000 jobs waiting on the provision of castings, but we do not regard it as an exaggeration. Thinking on similar lines, we estimate that in this country a rapid conversion of the iron-foundry industry would create a million jobs. Hence, there must be thoughout a scheme for making the general public fully aware of the fundamental role which the ironfoundry plays in the industrial set-up of modern civilisation. It may not have been a "cast-iron" war, but for the re-establishment of British economy it most certainly is a "cast-iron" peace.

THE TECHNOLOGICAL PRINCIPLES OF CASTING DESIGN

By VICTOR M. SHESTOPAL

The Author is a Professor of the Stalin Machine Tool Institute, Moscow

INTRODUCTION

Casting is one of the most important processes in the manufacture of all machines. By weight, castings form 85 to 90 per cent. of machine tools, 50 to 55 per cent. of tractors, 70 per cent. of escalators, 25 per cent. of crane bodies, trucks, etc. More than 20 to 25 per cent. of the total cost price of a machine is absorbed in the manufacture of castings.

The development of more durable types of cast iron has led to the more extensive use of iron castings. In a number of new designs cast iron has been successfully used in place of steel for the manufacture of crankshafts, spindles, gear wheels, etc. With the more extensive application of castings, greater importance must be attached to the design of the components from the viewpoint of the technological processes involved in their fabrication. Better designs make it easier for a factory to master the production of a new machine, reduce costs and make it possible to operate the foundry with less highly skilled workers.

The technological principles of casting design make themselves most strongly felt in plants engaged in the serial and mass-production of machines, where moulding is done mechanically and expensive pattern equipment is employed. The design of the whole casting as well as its elements and member junctions must take into consideration the phenomena which occur during the solidification and cooling of the metal. Unless this principle is followed it is impossible to obtain castings that are free from cracks, flaws and

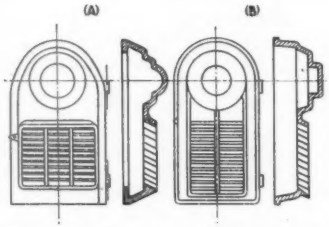

FIG. 1.—DOOR. (*a*) INCORRECT. (*b*) CORRECT.

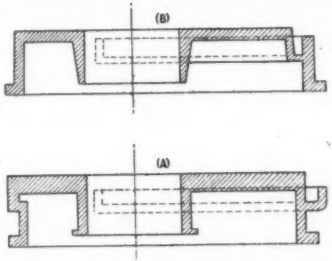

FIG. 2.—BASE. (*a*) INCORRECT; (*b*) CORRECT.

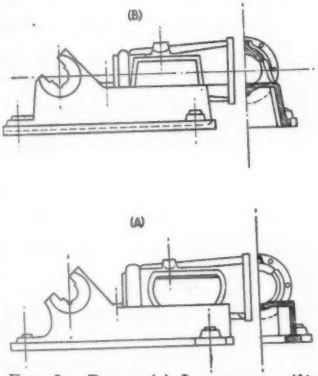

FIG. 3.—BED. (*a*) INCORRECT; (*b*) CORRECT.

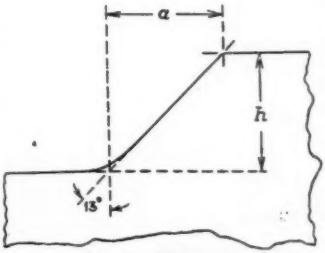

FIG. 4.—TAPERING.

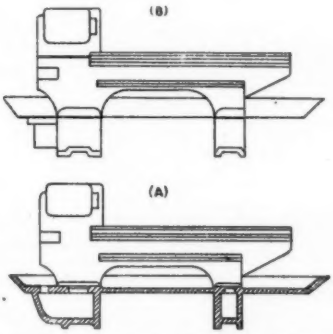

FIG. 5.—MACHINE BED. (*a*) INCORRECT; (*b*) CORRECT. (NOTE: THE CASTING IS MADE IN SECTIONS.)

Casting Design

internal stresses without employing special methods, complicating the whole technological process. The size and intricacy of the castings should not only be in accordance with the general technological principles of casting processes, but also in accordance with the specific conditions obtaining in the particular foundry where they are to be cast.

General Design of Castings

Simplicity in production demands simplicity in form. Every casting should be based on the simplest possible geometrical figure. The whole design should be based on the idea of obtaining this figure in the casting, and all the appendages, such as ribs, flanges, bosses, etc., should be subordinated to it.

In designing castings every effort must be made to obtain the simplest possible patterns and coreboxes. The shape of the various surfaces of the casting should

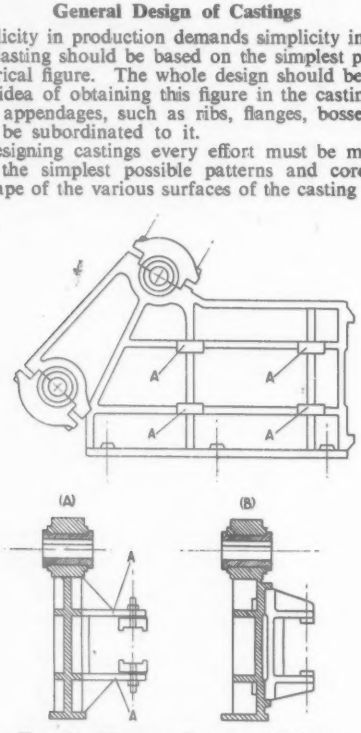

FIG. 6.—MACHINE FRAME. (*a*) INCORRECT; (*b*) CORRECT. (NOTE: THE SUPPORTS ARE MADE DETACHABLE.)

be made as close as possible to the plane or cylindrical surfaces in order to simplify the making of the pattern (Fig. 1).[1]

The design of the casting should provide for the easy withdrawal of the pattern from the mould without the use of loose pieces and irregular parting line, etc. The more complicated the design of the casting, the greater the number of cores, bosses, etc., the more difficult it is to achieve accuracy of dimensions. It is particularly desirable that there should be no loose pieces on jobs moulded mechanically and intended for machining in jigs and fixtures (Figs. 2 and 3).

To make it easier to remove the pattern from the mould it is desirable that the casting should be designed with the necessary draft. If this be not done

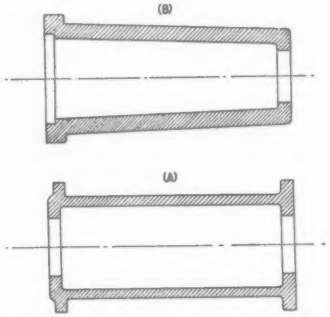

FIG. 7.—COLUMN. (*a*) INCORRECT; (*b*) CORRECT.

the patternmaker will have to taper the walls of the pattern, thus deviating from the dimensions of the job.

The U.S.S.R. Government Standard No. 2670-44, sponsored by the Stalin Machine-tool Institute, recommends the draft $\frac{a}{h} = \frac{1}{5} = \frac{1}{20} = \frac{1}{50}$ (Fig. 4), which corresponds to the angles β.

If the slope is obtained from the cast dimension a, the quantity $\frac{a}{h}$ may deviate from the figures given in Table I in order to avoid fractions. The tapered surfaces of the main part of the casting or its separate

TABLE I.—*Pattern Draft Laid Down in U.S.S.R. Specification No.* 2670-44.

$\frac{a}{h}$	β.	Remarks.
$\frac{1}{5}$	11 deg. 30 min.	where h is less than 1 in.
$\frac{1}{10}$	5 deg. 30 min.	Medium h.
$\frac{1}{20}$	3 deg.	
$\frac{1}{50}$	1 deg.	where h is more than 1 ft. 8 in.

components (bosses, ribs, brackets, bores, etc.) must coincide with the parting line of the mould.

Intricate and cumbersome castings are best designed

[1] Dikushin. "Machine Tools," 1944. Nos. 11 & 12.

in separate parts and after casting may be united by welding, bolting or some other method of jointing (Fig. 5). This applies in particular to parts of a casting which form large projections (Fig. 6) and later give rise

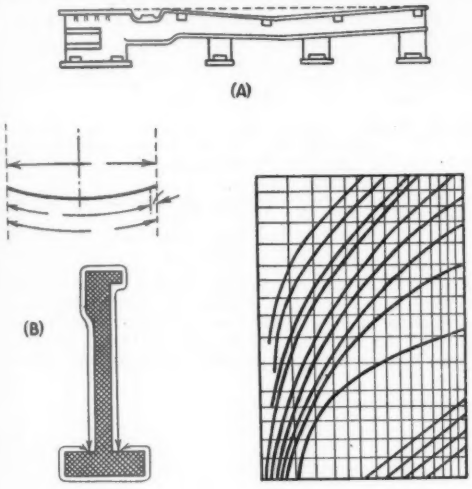

FIG. 8.—CALCULATION OF WARPAGE IN MACHINE-TOOL BEDS. (*a*) THICKNESS OF WAYS; (*b*) SHORTENING PER UNIT LENGTH; (*c*) RATIO BETWEEN RELATIVE SECTIONS OF WAYS AND WALLS.

to internal stresses. The cost of making moulds can rise very rapidly, and not necessarily in proportion with their dimensions. In addition to this, the division of the casting into a number of parts makes the moulds more simple to build up, obviates the use of heavy cranes, and permits of the employment of less skilled workers.

The design of the casting must be such as will allow the liquid metal to flow freely into the mould.

Large horizontal surfaces parallel to the top of the mould should be avoided on account of the fact that the gases which form in the mould and are given off from the metal may be retained on these surfaces. It is desirable to design that element of the casting which is uppermost in the mould in such a way that it will assist the free flow of the gas and produce a casting without gas cavities.

The design of castings should be such as to ensure a regular progression in the process of solidification. This means that the solidification should begin at a definite, known point in the casting, usually the point farthest from the gate where the liquid metal is poured and should spread from this point in direct sequence, ending with the head or riser. In the majority of cases the solidification process begins in that part of the casting which is at the bottom of the mould and ends with the parts nearest the top, the whole process progressing gradually. This rule must always be borne in mind when handling those metals the volume of which decreases considerably as they cool, such as steel, white iron, etc.

Every cross-section of the casting, especially at points where there are masses of metal, must be ensured a regular supply of liquid metal while the solidifying process is under way if cavities and porosity are to be avoided. The isolation of heavy cross-sections or their disposition in parts of the mould where they are not constantly supplied with liquid metal is particularly dangerous to the quality of the casting.

The design of the casting must allow for shrinkage and the checking of shrinkage caused by mechanical and thermal factors (Fig. 7). In order to prevent the so-called "mechanical" stresses, castings should allow for free contraction. To prevent "thermal" stresses, the design should provide for all cross-sections to cool as evenly as possible. The approximate criterion of the rate of cooling of a cast member is the relative thickness of the cross-section, that is, the area of the cross-section divided by its perimeter.

The designer must remember that internal stresses which arise are directly proportional to the modulus

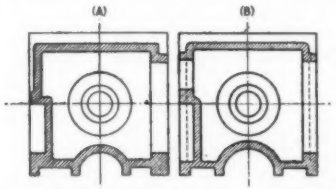

FIG. 9.—HOUSING. (*a*) INCORRECT; (*b*) CORRECT. (NOTE: IN (*a*) CHAPLETS MUST BE USED.)

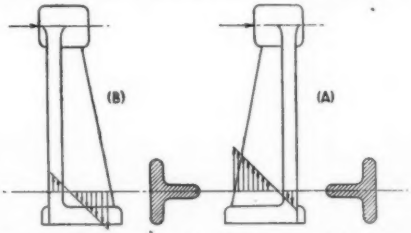

FIG. 10.—BRACKET. (*a*) INCORRECT; (*b*) CORRECT. (NOTE: THE TENSION STRESS IS GREATER THAN THE COMPRESSIVE.)

of elasticity of the metal. If the modulus of elasticity of steel averages 21,500 sq. kg./mm, white iron 17,000 sq. kg./mm., and grey iron 10,000 sq. kg./mm.; then, all other factors being equal, the ratio of stresses in steel, white and grey iron will be: 2.2:1.7:1.0.

In designing the beds of lathes and similar machines it must be remembered that the great difference in

Casting Design

relative thickness between the slideway and the walls of the bed will result in internal thermal stresses which may lead to the warping of the casting. Marker's researches undertaken to determine the extent of the warpage in beds for turret and other lathes enable one to calculate the deflection f by the following formula:

$$f = \frac{h}{4}\sqrt{6c}\,;\; h = l - 3h - \frac{3M}{e}(H - h),$$

where C is the shortening per unit length of the bed determined in accordance with the ratio between the relative thickness of the cross-section of the slideways and the walls, and with the section of the slideways in accordance with Marker's diagram (Fig. 8); l = the given length of the bed measured along the horizontal; h = the height of the bed in mm.; H =

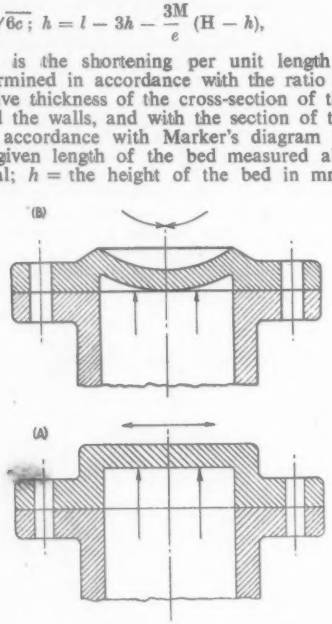

FIG. 11.—PISTON. (*a*) INCORRECT; (*b*) CORRECT.

the length of the legs from the slideways, or where there are no legs the height of the wide walls; and m = the length of all the legs or the length of the wide part of the bed.

Where the walls of the assembly are not all of the same cross-section, as is the case in some designs, the distortion of each wall must be calculated separately and then an average figure taken.

The following ratios must be maintained for cast-iron flywheels and pulleys:—

$$\text{Flywheels}: 0.5D = 2l\,0.5\,\frac{Ks}{Kr} + d\,0.5\,\frac{Kh}{Kr}$$

$$\text{Pulleys}: 0.5D\,\frac{Kr}{Kh} = 2l\,0.5\,\frac{Ks}{Kh} + d\,0.5.$$

where D is the diameter of the wheel; l = the length of the spokes; and d = the diameter of the hub.

Kr, Ks, Kh } Coefficients equalling the inverse ratio of cross-section to the perimeter of rim, spokes and hub.

The following empirically obtained ratios between the structural elements of pulley wheels are also recommended:—

$$\frac{Fs}{Ps} : \frac{Fr}{Pr} = 0.9\,;\; \frac{Fh}{Ph} = 0.4\,;\; \frac{Fr}{Pr} \cdot \frac{1}{1 - \frac{100A}{d}}$$

where Fs, Fr, Fh = the area of the cross-section in sq. mm. and Ps, Pr, Ph the perimeter of the cross-section of the spokes, rim and hub.

d = diameter of the hub.

A = a coefficient depending on the diameter of the pulley D in mm.

D mm.	....	300	400	500	600	700	800	900	1,000
A	....	0.39	0.52	0.55	0.73	0.51	1·0	1.18	1.3

The inevitable deformation of wooden patterns, the imperfect nature of sand moulds,[2] and variations in the shrinkage of the metal may cause certain deviations from the required dimensions and weight of the casting. The extent of permissible deviations for cast

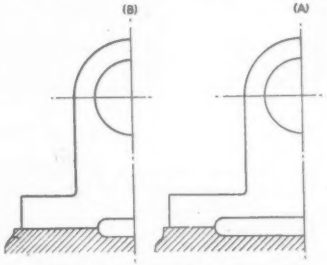

FIG. 12.—BEARING. (*a*) INCORRECT; (*b*) CORRECT. (NOTE: THE CROSS-SECTION HAS TRANSVERSE STRESSES.)

iron and cast steel are laid down in U.S.S.R. Government Standards 1855-42 and 2009-43, and are given in Tables II to V.

These figures are the highest permissible and do not prevent severer standards from being set, often for whole branches of industry where the foundries have achieved a higher all-round standard.

Table II gives the greatest permissible deviations.

Up to now there are no U.S.S.R. Government Standards of permissible deviation in dimensions and weights for other metals.

Tables VI to IX show the recommended permissible deviations in dimensions and weights for castings for malleable iron and copper alloys worked out by the Central Research Institute of the Heavy Machine Building Industry.

2 The present article does not deal with specific conditions of die casting, centrifugal casting, etc.

TABLE II.—*Maximum Permissible Deviations in the Dimensions of Grey Iron Castings.*

Dimensions of castings in mm.	Degree of accuracy.					
	I.		II.		III.	
	Maximum deviation in mm.					
	Upper (+).	Lower (−).	Upper (+).	Lower (−).	Upper (+).	Lower (−).
Up to 100 mm.	1.0	1.0	1.5	1.0	2.0	1.0
100–200 mm.	1.0	1.0	2.0	1.0	2.0	2.0
200–300 mm.	1.0	1.0	2.0	1.5	3.0	2.0
300–500 mm.	1.5	1.0	3.0	2.0	4.0	3.0
500–900 mm.	2.0	1.0	4.0	2.0	5.0	3.0
900–1,200 mm.	3.0	1.5	5.0	3.0	6.0	4.0
1,200–1,800 mm.	4.0	2.0	6.0	4.0	8.0	5.0
1,800–2,600 mm.	5.0	3.0	8.0	5.0	10.0	6.0
2,600–3,800 mm.	6.0	4.0	10.0	6.0	12.0	8.0
3,800–5,400 mm.	8.0	6.0	12.0	8.0	15.0	10.0
Over 5,400 mm.	10.0	8.0	15.0	10.0	20.0	15.0

TABLE III.—*Maximum Permissible Deviations in the Dimensions of Cast Steel.*

Dimensions of castings in mm.	Degree of accuracy.					
	I.		II.		III.	
	Permissible deviation in mm.					
	Upper (+).	Lower (−).	Upper (+).	Lower (−).	Upper (+).	Lower (−).
Up to 100 mm.	1.0	1.0	2.0	1.0	3.0	2.0
100–200 mm.	1.0	1.0	2.0	1.0	4.0	2.0
200–300 mm.	1.0	1.0	3.0	2.0	4.0	3.0
300–500 mm.	1.5	1.0	3.0	2.0	5.0	3.0
500–800 mm.	2.0	1.0	4.0	2.0	6.0	4.0
800–1,200 mm.	3.0	2.0	5.0	3.0	7.0	5.0
1,200–1,800 mm.	4.0	2.0	6.0	4.0	9.0	6.0
1,800–2,600 mm.	5.0	3.0	8.0	5.0	12.0	8.0
2,600–3,800 mm.	6.0	4.0	10.0	6.0	14.0	10.0
3,800–5,400 mm.	8.0	6.0	12.0	8.0	16.0	12.0
Over 5,400 mm.	10.0	8.0	15.0	10.0	20.0	16.0

TABLE IV.—*Maximum Permissible Deviation in Weight in Grey Iron Castings.*

Weight of casting in kg.	Permissible deviation in weight, per cent.		
	Degree of accuracy.		
	I.	II.	III.
Up to 100	5.0	8.0	10.0
100–1,000	4.5	6.0	10.0
Over 1,000	3.0	5.0	8.0

TABLE V.—*Maximum Permissible Deviation in Weight in Steel Castings.*

Weight of casting in kg.	Permissible deviation in weight, per cent.		
	Degree of accuracy.		
	I.	II.	III.
Up to 100	6.0	8.0	10.0
100–1,000	5.0	7.0	10.0
Over 1,000	4.0	6.0	8.0

Casting Design

TABLE VI.—*Permissible Deviations in Dimensions of Malleable Iron Castings.*

Dimensions of casting in mm.	Degree of accuracy. Permissible deviation in mm. ±.	
	I.	II.
Up to 100	0.5	1.5
100–250	1.0	2.0
250–400	1.0	2.5
400–650	1.5	3.0
650–1,000	1.5	3.5
1,000–1,600	1.5	4.0

TABLE VII.—*Permissible Deviations in the Dimensions of Copper Alloy Castings.*

Dimensions of castings in mm.	Degree of accuracy. Permissible deviation in mm. ±	
	I.	II.
Up to 150	0.5	1.0
150–250	0.5	1.5
250–600	1.0	1.5

TABLE VIII.—*Permissible Deviation in the Weight Per Cent. of Malleable Iron Castings.*

Weight of casting in kg.	Degree of accuracy. Permissible deviation in mm.			
	I.		II.	
	Upper (+).	Lower (−).	Upper (+).	Lower (−).
Up to 0.5	6	5	11	10
0.1–0.5	6	5	9	9
0.5–2.5	5	5	8	8
2.5–12.5	5	4	7	7
12.5–52.5	4	4	6	6
Over 52.5	4	3	5	5

TABLE IX.—*Permissible Deviation in the Weight Percentage of Copper Alloy Castings*

Weight of casting in kg.	Degree of accuracy. Permissible deviation in mm.			
	I.		II.	
	Upper (+).	Lower (−).	Upper (+).	Lower (−).
Up to 0.1	6	5	11	11
0.1–0.2	5	5	10	10
0.3–0.4	5	4	9	9
0.4–0.8	4	4	8	8
0.8–1.6	4	3	7	7
1.6–3.2	3	3	6	6
Over 3.2	3	2	5	5

When there are rough castings in a machine moving one against another, the minimum clearance recommended is given in Table X.[3]

TABLE X.—*Minimum Clearance in mm.*

	Dimensions of castings.		
	Up to ½ m.	Up to 2 m.	Over 2 m.
One surface as cast, other machined	10	15	25
Both surfaces as cast	10	20	30

The drawings should show the locating surfaces to be used in machining, so that they may serve as a starting point in making the pattern and in checking the patterns and the castings.

In designing the casting, care must be taken to ensure the possibility of removing heads and risers, knocking out the cores and core irons.

The design of the casting should also take into consideration the extent to which the later use of the part will depend on the method of casting. If, for example, the casting is intended to work under pressure, its design should be such that the cores can be held in the mould by core prints without any recourse to chaplets.

By distribution of loads in the construction, the design should take into consideration the properties of the metals used. For instance, a grey-iron casting is better used under compression than in tension (Figs. 9, 10, 11 and 12), while steel, on the contrary, works equally well under both stresses.

(*To be continued.*)

THE METALLURGIST IN INDUSTRY

In his inaugural address as president of the Birmingham Metallurgical Society, at Birmingham recently, DR. J. W. JENKIN, Director of Research of the Tube Investments Group of engineering industries, said that, while marketing and salesmanship had their important place in Britain's drive to develop exports to pay her way, equal energy must be devoted to basic research which would ensure not only a flow of new produce, but a rising output and standard of quality in existing products. In that field of standards of materials, the metallurgist had his part to play. The materials used by the engineer must, in the interests of public safety and the advancement of industry, be beyond doubt; in fact, all engineering developments had depended upon the ability of the metallurgist to find materials which would withstand the tremendous stresses, high temperature, and other exacting demands, made by modern mechanisation. Referring to the recently formed Institution of Metallurgists, the speaker said it would give the metallurgist the status and recognition which he had long merited, but that was not the primary consideration. What had happened was that British metallurgists had got together and established a professional body which would ensure both the maintenance and development of skill and knowledge of its members.

[3] Geiger. Transactions A.F.A., 1942, pp. 149-176.

THE GATING AND FEEDING OF STEEL CASTINGS

By S. T. JAZWINSKI, Dpl.-Ing.Met. (Member), E. D. WELLS, Assoc.Met. (Member), and S. L. FINCH (Member)

Discussion on a Paper read at the annual meeting of the Institute of British Foundrymen, Mr. P. H. Wilson, O.B.E., in the chair. The Paper was printed in our issues of November 15, 22 *and* 29.

Arc Feeding

DR. DADSWELL said that the Authors were to be congratulated on this Paper. From time to time Papers were written on the subject of feeding, gating, and so forth, but they dealt with the matter in a general way, touching only on the fringe of things, glibly talking about control solidification and directional solidification, but seldom getting down to fundamentals. The Authors had in a concise manner endeavoured to analyse why certain things happened in the feeding of castings. They had thrown quite a new light on this problem of feeding, and this was a time when it could have a great value, because during the last few years the method now known of whirlgate feeding or running the casting had developed.

The Authors mentioned the method of conserving heat in the feeder head, and said that at the present time the methods of conserving heat in a feeder head by substituting an insulating material for the sand forming the head shape, and also the keeping of the head liquid by such means as a small electric arc, were possible, but difficult to apply on a commercial basis. Admittedly for the type of casting mentioned in these Papers,* they would be difficult, but he would like to mention that for castings of 5 tons up to 150 tons the method of the electric arc for keeping the feeder head liquid was in common use and enjoyed great success. It led to very large economies, and ensured soundness which natural feeding methods were not able to give economically for very large castings. By means of an arc, one could get down to very low percentages of the order of 10 per cent. From the Table given in the previous Paper† he thought the figure for liquid steel required was 4.6 per cent. One could not attain to that for even electric feeding because of segregation and, when the head was removed, the ill-effects were revealed on the casting.

MR. S. T. JAZWINSKI said that he fully agreed that the question of heating feeder heads by arc on large castings was a good proposition, but on the question of segregation and of the theoretical 5 per cent. mentioned, he would say that it was a question of the type of shrinkage cavity. If a flat bottom shrinkage cavity could be obtained, the segregation would probably not be dangerous.

DR. DADSWELL rejoined that he had had three arcs in one head and had found it possible to feed down to the head practically flat. They had from that point of view increased the amount of head to bring up the segregation.

Liquid Contraction Factors

MR. BELL congratulated the Authors upon a very thorough and workmanlike Paper. There was one factor which stood out. He was sorry to have to refer again to the previous Paper,* but the liquid contraction there was given as 7.9, whereas in the present Paper it was given as between 4 and 6 per cent. Could the two be reconciled? Tables I and III were excellent examples of the simple presentation of true facts of the best British practice, and the results shown, especially in Table III, corresponded to the best practice ever produced in Britain and were totally different from the facts presented in the tables in the previous Paper.*

Gating to Eliminate Use of Chills

MR. KAIN said that this Paper was very impressive, and he thought that K. & L. Steelfounders & Engineers ought to be congratulated on having a team working together to produce a joint Paper such as this. In the example referred to in Fig. 12, an alternative method of obtaining soundness in this casting would have been to increase the height of the subsidiary heads instead of using a system of chilling. Chills were very useful, but they were always a potential source of trouble, and in his foundry they made it a practice not to use them if they could achieve their ends by any other method.

The statement that each head should be isolated in its effect and should not on any account interfere with the efficiency of any other head on the casting was very good, and might well have been printed in large type and underlined. It was a principle which, in steel foundries particularly, they did not sufficiently realise. They did not seriously think of isolating the effect of each head. He suggested that in the Paper when finally published that sentence might be underlined.

With regard to top feeding, the Authors said that this was a very good method and a practical one. But there was one system of gating to which no reference had been made, namely, pencil gating through a series of small gates in the top of the casting. This could be used even in a steel foundry with very great success, and in his own case they could, with suitable castings of the circular type, hubs, wheels and the like, claim a yield as high as 75 or 78 per cent. They could also manage to achieve it successfully

* The one under discussion is "A Study of Moulding Methods for Sound Castings" by Frederick G. Sefing.
† Mr. Sefing's Paper.

* Mr. Sefing's Paper.

with green sand. They found that with carefully controlled sand and a very hard mould it could be used successfully in that way.

In discussing the speed of metal supply to the actual casting, the Authors mentioned as the first variable the velocity of metal entering the runner bush. That was important, but the controlling factor in the running of steel castings by the present method of pouring through a nozzle was the skill of the operator. The Foundry Practice Sub-committee of the Iron and Steel Institute had carried out a short series of tests on this, using one casting in two foundries, and although they took careful precautions to get variable pouring speeds or times, they found that the speed of pouring was absolutely at the mercy of the ladleman, and it was impossible to get perfectly standard pouring conditions. They would do well to try and find an alternative method.

In centrifugal casting the Authors claimed the advantage of increased soundness and cleanliness. He was interested in that, because when the metal was poured into a rotating mould the velocity of the metal flowing over the mould surface was very high. What was necessary in order to ensure cleanliness? He had himself made one or two experiments, and had found that the question of gating a clean casting was very difficult.

He thought that the Authors might have laid greater stress on the fact that, having obtained a head with metal at a higher temperature than the casting, it was necessary to apply pressure to force that metal in the areas of low temperature. That point was not quite clearly brought out, and he thought some clause to that effect should be introduced. He did not wish his remarks to be interpreted as criticism, because this was a remarkable Paper, the more so because it was the joint effort of several people instead of one.

Atmospheric Feeding

MR. E. J. BROWN said he was somewhat confused regarding this sudden claim to use atmospheric pressure as a feeding agent. He could not see the difference in principle between an ordinary open head as distinct from what was an enclosed semisphere with a small air inlet. Both admitted of atmospheric pressure, the real difference being that with the open head unless due precautions were taken freezing took place, while the spherical top helped to conserve the heat. Reference to Fig. 3 may illustrate the point. Casting through a whirlgate, of course, resulted in the maximum temperature at the desired situation, and the good results obtained by side feeding were largely, in his opinion, due to this fact.

The efficiency of a feeder head should be measured by the amount of metal which enters the casting, and in this respect the inherent shrinkage of the actual head was often forgotten, it being assumed that the amount of cavitation was the degree of feed. He had never been able to see why one should not adopt the simple expedient of casting a head strictly comparable in size to that used on the casting, then measure or weigh the difference between the two, thus determining the efficiency. On the question of temperature gradients, as illustrated by isothermic lines in Figs. 14, 15, 16 and 17, were these conjectural, or were they the result of scientific experiment?

MR. J. H. COOPER said that so far as liquid contraction of metal was concerned he had been engaged on experiments in which it was found that the actual fluid contraction in steel was about 5 per cent. That was on the determination of the condition of the steel as it went into the mould, and he did not think there was any fixed rule as to how the metal did go in. If they could keep the metal in the head of the same quality as the original they produced a casting which was sound and free from segregation.

A MEMBER said that he did like the way in which they had advocated the breaking up of the casting into the heavier and the medium parts and getting hot metal into the heads at one and the same time.

MR. J. T. WELLS felt that one or two of the previous speakers had been confusing the theoretical feed capacity with the practical feed capacity. In other words, all the metal of the feeding head did not enter the casting. Where there had been trouble it had usually been traceable to one of two causes: (1) Lack of entry of atmosphere to the head, (2) heads not large enough. The heads had frozen off, the castings had frozen, and in between the two was a hot spot which should have been in the head. In other words, the head should have been a little larger.

MR. S. L. FINCH, referring to the question why an open type of gravity head was not as efficient as the atmospheric head, said that if both were kept open to pressure, then they had the same feed pressures, so that two more factors came into play.. They must have the hottest metal in the heads and this they got with an atmospheric whirlgate head. The other factor was heat radiation, which was much less in the atmospheric head.

Liquid Contraction—a Range

MR. S. T. JAZWINSKI, referring to liquid contraction, said that this depended on the casting temperature, whether high or low, and therefore no one figure could be stated; they must always give a range. With regard to the actual figures, various investigators, British, American, and German, gave 5.5, but if one was casting from lower temperatures, it would be 5 or lower, and therefore the figures 4 to 6 were taken.

The CHAIRMAN (Mr. P. H. Wilson, O.B.E.) said that he would like on behalf of the members to extend to the Authors of this most interesting Paper their best thanks. In his opinion this was an all-important subject, not only in connection with steel, but equally so in connection with cast iron and other materials. It was one which should be tackled on scientific lines, and this was a very helpful contribution towards a really scientific study of an important subject in the foundry. Taking general casting, who was the man who decided how it was going to run, the size and shape and position of the runner and all the other important factors in connection with the making of

the castings? It was probably the foreman or the patternmaker himself. He knew that it was probably impossible to provide a text book which would give exactly all the data necessary in connection with this subject, because castings, and probably conditions, varied to some extent, but he thought it was possible at least to settle the principle of the process along with sufficient data from which it should be an easy matter to decide on those details which had been discussed that afternoon. He felt that despite these excellent Papers there was still a great deal of scope for further investigation. He had just one point on which to ask a question of the Authors. So far as the form of centrifugal casting was concerned, he assumed that that applied to a sand mould.

MR. JAZWINSKI agreed that that was so.

The session terminated with the usual vote of thanks.

MR. F. SWIFT, M.B.E., wrote: Some years ago, when he was responsible for making up casting heats from 30 to 65 tons in the ladle, and careful checking of delivered weights in specified heats and the weight of feeder heads, etc., it was quite evident that there was a great difference between the fluid and solid. Although he used to allow 1 ton to 30 cwts. extra from the melting department, there were 3 to 5 tons to spare, and even more at times. This continual spare from every heat caused, quite naturally, a certain amount of criticism from the manager on the calculation of amounts required for any particular heat. After a long discussion, permission was granted to experiment with three blocks at 6-in. dia. by 12 in. deep, and three blocks at 6 in. sq. by 12 in. deep, all in different heats and varied carbons.

The majority of the text-books give the following weights for blocks of the above dimensions of solid steel, *viz.*: 6 in. dia. by 12 in. deep = 96 lbs.; 2.64 cylindrical inch by 12 in.; 6 in. sq. by 12 in. deep = 122 lbs.; 3.4 sq. in. by 12 in.

Herewith results of experiments made in February, 1918. The vessels used were Stock converters.

Heat No.	Carbon.	Weight in lb. fluid.	Solid.
H.4689	0.27	86	96 lb.
H.4706	0.26	87	
G.6172	0.29	88	
		6 in. dia. × 12 in. long	
G.6000	0.30	110	
G.6008	0.19	112	122 lb.
G.6011	0.26	109	
		6 in. square × 12 in. long	

This foundry experiment proved that there is quite an appreciable difference between solid and fluid, and since the above date the management have used the knowledge gained from this. To be on the safe side for calculation purposes, the heaviest specimen in each case, *viz.*, 88 and 112 lbs. respectively, are taken. From these figures all the necessary factors for the various shapes, etc., squares, diameters, octagons, hexagons, etc., were obtained. It is thought these notes might be helpful to members, and probably others will try this in their foundry and publish their results in the near future.

Mr. Jazwinski's Reply

MR. JAZWINSKI replied: First of all, one should consider the shrinkage from casting soundness point of view. The total contraction refers to the sum of contraction from solidus to room temperature, total liquid shrinkage and shrinkage on solidification. Only these last two shrinkages are important from the feeding point of view. Irrespective of size of the contraction in the solid state, the casting cannot be fed after the solidus has been reached. On the other hand, a knowledge of the total contraction is absolutely necessary for the patternmaker.

The figures so far known are obtained from direct experiment, but only up to the liquid state; the rest in the liquid is extrapolated. The experimental figures have been confirmed quite well by the lattice parameter. The total contraction of pure iron from 1,530 deg. C. down to room temperature is evaluated as 9.6 per cent. Steel has a rather higher contraction, somewhere about 11 per cent., and can be as high as 14 per cent. if the carbon content is nearly 1 per cent. The whole mechanism is further complicated by the presence of other elements, such as Si, P, Mn, etc.

Referring to the Paper where a 4 to 6 per cent. shrinkage was mentioned, I had in mind liquid shrinkage plus shrinkage on solidification. This range covers the cases where high pouring temperature is employed in low carbon steel. In normal foundry practice the amount of metal necessary to feed the casting due to these two shrinkages is probably not higher than 3 per cent. Again I would like to stress the point that the amount of metal necessary to feed a casting varies according to casting temperature, chemical composition and ratio of total surface area exposed for cooling to the weight of the actual casting. If this ratio be increased, the amount of metal necessary for actual feeding to obtain a sound casting is decreased.

From Mr. Swift's experiments I should say that in both cases the steel density in the solid state is exactly 7,875 per c.c. (9.6 per cent.), which is in accordance with the most reliable published figures. The total shrinkage in his experiments varies as follows:—

		Per cent.	Per cent.
6 in. dia.	H.4689	10.4	
12 in. long	H.4706	9.4	
	G.6172	8.3	Average 9.37
6 in. square	H.6000	9.8	
	G.6008	8.2	
12 in. long	G.6011	10.6	Average 9.5

Bearing in mind the percentages of total contraction in this experiment, it is possible to draw the following conclusions:—(1) Figures given for carbon content cannot be in any way related to the amount

The Gating and Feeding of Steel Castings

of total shrinkage. (2) The shapes of the experimental blocks did not affect the mode of contraction. There is too small a difference in relative surface area. (3) The differences in contraction are probably due to differences in casting temperature, which unfortunately is not available. After consideration of Mr. Swift's data the differences in total contraction should be attributed mainly to difference in casting temperature, *viz.*:—
Heats G.6011 and H.4689 cast from 1,550 to 1,570 deg. C.
Heats H.4706 and G.6000 cast from 1,530 to 1,540 deg. C.
Heats G.6172 and G.6008 cast from 1,500 to 1,515 deg. C.

From the American Exchange Paper by Mr. Sefing the total contraction can be assumed to be about 15 per cent., which, in my opinion, is too high. Of course, there is no indication in Table I for what type of steel the Author considered the shrinkage figures, but, nevertheless, a shrinkage during freezing of 4.5 per cent. is higher than any figures so far quoted.

MR. C. H. KAIN wrote:—One of the great difficulties in using the atmospheric head system for feeding steel castings is the insertion and fixing the pencil core in the top of the head. In large feeders it is possible to push the core in and secure it firmly in place with gum or by some other means, but in this case the core sometimes breaks off during pouring. In the case of small heads, it is often difficult to push the hand into the head to put the small core in place. An alternative method is to bore a hole in the top of the feeder pattern and to drop the pencil core in this before ramming the mould; the core then draws away from the head pattern when the mould is stripped. Again, these cores frequently break.

FIG. A.—MR. HARDY'S ARRANGEMENT FOR ATMOSPHERIC FEEDING WHICH ELIMINATES THE USE OF A PENCIL CORE.

FIG. B.—SECTION CASTING FED BY MR. HARDY'S METHOD.

The photographs (Figs. A and B) show a method devised by Mr. W. L. Hardy of introducing atmospheric pressure to the top of the feeder without the difficulties of the pencil core. A groove or notch is made in the top of the feeder head pattern, and this is rammed up as part of the mould. The two illustrations show clearly that this is at least as effective as the pencil core. Experience shows that the method is equally effective in green and dry sand, and even if the projecting tongue of sand fuzes, it will perform its function satisfactorily.

MR. F. ANDREW has changed his address from Failsworth to 44, Regent Road, Rhyl, North Wales.

THE WHITING CORPORATION, of Harvey, Illinois, has now acquired the exclusive rights from the B.C.I.R.A. for the manufacture and sale of the balanced-blast cupola in the United States.

DOLOMITE LININGS FOR BASIC ELECTRIC-ARC FURNACES

REVIEW OF REFRACTORY PERFORMANCE DATA

A Paper on "Dolomite Linings for Basic Electric-arc Furnaces" was submitted by Mr. E. C. Brampton, Mr. H. Parnham and Dr. J. White to the autumn meeting of the Iron and Steel Institute. The following is a synopsis of their work.

The severity of the conditions to which refractory linings are subjected in the basic electric furnace is indicated by the fact that the life obtained is generally only one-third to one-quarter of that obtained in comparable positions in the open-hearth furnace. The special conditions to which the refractory is subjected in the arc furnace are discussed, and the need for collaboration between the refractory maker and the furnace user is stressed. A brief account is given of the development of basic linings for electric furnaces, with particular reference to the development of the 100 per cent. dolomite brick, which has been widely adopted in this country in recent years. The advantages of this brick are discussed. An account is given of a trial in a 4-ton furnace of a 100 per cent. dolomite brick roof which gave a life of 57 heats under severe conditions. Clear indications were obtained during the trial that such a roof would make the attainment of higher furnace temperatures possible, and would materially increase side-wall life.

A review of refractory performance data supplied by the users of furnaces in which 100 per cent. dolomite brick linings are employed is given, and the general method of installing such linings is indicated and illustrated by diagrams. The methods of manufacturing dolomite bricks, both of the stabilised and of the 100 per cent. type, are described in general terms.

Increased Resistance to Fluxing

An account is given of a series of investigations relating to the behaviour of 100 per cent. dolomite bricks in arc furnaces. A notable feature is that, as a result of drainage and of migration of lime in the form of fusible compounds away from the hot face, the working face of the brick tends to acquire increased resistance to fluxing while in service. X-ray analysis shows that in used bricks the zone in the immediate vicinity of the working face consists mainly of spinel and periclase, with other divalent oxides in solid solution. Analytical and X-ray data are also given for the principal zones formed behind the hot face in portions of brick removed from a furnace at the end of the oxidising and reducing periods respectively, and the effects of the fluctuating atmospheric conditions are discussed. It is shown that the phases identified in the various zones are consistent with known equilibrium phase data for the system CaO-MgO-Fe_2O_3(FeO)-Al_2O_3-SiO_2. The occurrence of "flaking" or splitting-off of the brick at a position between 1 and 2 in. behind the hot face, which sometimes occurs with dolomite bricks (as well as with other basic refractories) as a consequence of flux penetration, is also described and possible mechanisms discussed. Stress is laid on the importance of maintaining adequate support at the hot face and of avoiding excessive undercutting to ensure optimum performance.

The application of the method of sulphur printing on bromide paper to demonstrate the presence of sulphur as sulphide in used bricks is also described, and it is shown that the concentration of such sulphide is low in the vicinity of the hot face and reaches a maximum in certain light-coloured zones some distance into the brick. This is probably responsible for a certain "softening" observed in used bricks in a zone immediately beyond the limit of flux penetration. Analyses are given of gas samples drawn from furnaces during the refining (reducing) period. These indicate that very highly reducing atmospheres may arise at certain stages of the refining process, and that reduction of iron oxide at 1,600 deg. C. to a stage intermediate between FeO and Fe_3O_4, but approaching the former, is to be expected.

Samples of refining-period fume have also been analysed, and the "fixed" constituents were found to be mainly MgO, CaO, iron oxide, and silica. There was also an appreciable content of carbon, apparently combined, and of sulphur as sulphide. The mechanism of fume formation is discussed, and its importance as a source of flux deposition on the refractories is indicated. Its composition is such that basic refractories will be much less affected by it than acid refractories.

QUALITY CONTROL

The extensive work of maintaining quality control is well demonstrated in a recent article published in the house organ of the American Cast-iron Pipe Company. It is indicated that in chemical analysis, involving not only melts and the finished products, but samples of raw materials as well, such as ferro-alloys, an average day's work might include the following number of determinations:—Silicon, 41; sulphur, 68; manganese, 32; phosphorus, 45; carbon, 62; nickel, 1; molybdenum, 2; chromium, 2; copper, 2. In the physical laboratory where all kinds of tests are necessary, such as hardness, tensile, etching, impact, etc., the daily number is well over 100 and periodically a complete pipe-bursting test is carried out. Sand for moulds and cores must be checked; also tars and other material used. Spectrographic determinations may run to 200 daily.

IRON AND STEEL OUTPUT IN SPAIN

The production of pig-iron in Spain during 1944 amounted to 570,000 tons compared with 543,000 tons in 1943. The output of steel ingots was 665,000 tons compared with 656,000 tons in the previous year. Fuel shortage is said to have been responsible for the fall in steel output, although why it did not affect pig-iron production is unexplained.

Company Meeting

HALE & HALE (TIPTON), LTD.

FINE WAR CONTRIBUTION

The ninth annual general meeting of Hale & Hale (Tipton), Limited, was held on December 10 at Dudley, MR. W. EDGAR HALE, M.I.Mech.E., M.Inst.F. (chairman of the company), presiding.

The following is the chairman's review of the company's activities for the year ended August 4, 1945, circulated with the report and accounts:—

It was not long after the formation of the company before we experienced the unfortunate slump in industry, which occurred in the later thirties, and I am sure that everyone will agree that during that difficult period this company acquitted itself well, and continued, in spite of all the difficulties, to build up the excellent commercial enterprise which is so well known under the title of "Hale & Hale (Tipton), Limited, manufacturers of 'fine' blackheart malleable castings."

During the strenuous years of war, your company were able to contribute magnificently to our country's desperate needs, and it is a great source of mental satisfaction to those of us, not only members of the board, but also members of the staff and the artisans of the works, whose real life work is embraced in this organisation to know that their untiring efforts were of so vital consequence at that important hour.

Our effort, of course, does not compare in so far as volume of production is concerned with the great armament firms, and the like, but nevertheless, I would unhesitatingly say that there is no comparable commercial organisation in the country which put up a finer show than this company did.

Owing to the fact that this company produces "raw material," we are not in a position to state that we produced so many tanks, so many tons of shipping, so many millions of this or that kind of war equipment, but we are in a position to say that our production in terms of money ran into millions of pounds.

Standard Maintained

During the year, the high standard of material and workmanship, for which your company is so well known, has been maintained. Confidence in the merit of Hales' blackheart malleable iron is increasing among leading designers and engineers, and the demand upon us for castings of intricate design and subject to high stresses is, as a result, becoming continually greater. Nevertheless, we are not content to rest on our oars. Our highly competent metallurgical staff is always devoting considerable time and effort to research and experiment. We have no doubt that the future will bring still further improvement in our products already so well to the fore.

The sales side of our organisation is very active these days; but the demand for our products far exceeds the supply. We know that this state of affairs is only a temporary one, but full scope cannot be given to our productive possibilities until there is a material improvement in the labour position.

We still maintain a very heavy order-book for many varied types of castings, all required urgently for home and export markets. We are committed to most of the heavy engineering industries, and are anxious to assist in getting their post-war programmes under way. If we can obtain the appropriate support from the authorities to enable us to consolidate our labour strength, we can then look forward to a long and steady period of development.

The field of application for blackheart malleable continues to increase. During the war years our material has been put to many new uses, more and more engineers are becoming "Hales' blackheart" minded, and we hope the time will not be far distant when we can fully satisfy the requirements of this widening circle of users.

Subsidiary Companies

You will be interested to have some idea as to what is transpiring with our two subsidiary companies. There is, first, Chatwins, Limited, located at Market Foundry, Tipton, where they manufacture grates, ranges, etc., and a very extensive line of cast-iron goods which are in wide demand for the housing programme, and we are looking forward to seeing this subsidiary growing from strength to strength. They have a very heavy order-book there, and excellent manufacturing facilities for a large output; in fact, I rather incline to the view that this subsidiary might quite well grow until its dimensions are approximating to those of the parent company.

Then there is J. & J. Whitehouse (Tipton), Limited, who are engaged in the production of goods in cast iron, mainly for export, and this company also has a very heavy order-book, and what would appear to be a very bright future. Since last year, the manufacturing facilities of the latter company have been moved to the premises of Chatwins, Limited, and their own premises have been sold. Your directors are satisfied that this transaction was a wise and beneficial one in all respects.

To put the position briefly, the past represents a satisfactory picture; the current position represents a more satisfactory picture still; but what of the future?

Industrial Outlook

I have repeatedly stated that industry as a whole can be likened to a very delicate plant, and damage at some point or other, no matter how slight, can cause it to die down, but to resuscitate that plant invariably proves a very lengthy and arduous task. At the moment I rather feel that the political arena has it within its grasp either to damage or to tend the plant with essential care; and our present Government has a colossal task before it if industry is going to continue on a broad and effective line, and so bring to us all those social amenities which everyone so ardently desires.

Unhappily, there has crept into the minds of the younger generation an idea that the serious efforts of their forebears in industry are no longer necessary, and that out of general apathy they are going to enjoy prosperity. That is, of course, a frightful fallacy.

and to eradicate it is something that the Government of the day must and will have to do.

In addition, there is the question of taxation, not only in so far as it may affect trading organisations, but also as it affects the individual. There are certain types of taxation which are doing much harm to the mental outlook of the main body of the people; but I am happy to observe in the Press, almost from day to day, that the Ministers of the Crown do recognise these two very important features.

We hear and read much in these days of nationalisation, but do not let us be too sceptical of its effects, where plain unbiased common sense suggests that good will arise therefrom. It is no use eternally hanging on to some fixed idea, and to do so deliberately, for the sake of doing so, and be absolutely unbending by reason of an alleged basic principle.

British industry has to face the most difficult period it has ever had to contend with; but if we keep politics well in the background, and keenness and enthusiasm in the foreground, we shall come through, I am sure, in great form.

Trading Profit

The trading profit for the year, by virtue of the taxation remaining constant, is roughly the same as previous years—namely, £25,000, from which has to be deducted depreciation and other items, leaving a balance of £17,528. The amount carried forward from last year, together with the net profit for the current year, produced a total of approximately £27,000, from which has to be deducted the preference dividend to June 30, 1945, and the interim dividend on the ordinary shares alread paid, thus leaving a balance of approximately £22,000. It is recommended that a final dividend on the ordinary shares of 12½ per cent. be paid, this being an increase of 2½ per cent. upon the previous year.

In conclusion, I trust that the proprietors will feel that the cautious handling of the company's finances are all for the best in the end; and failure to be cautious can so easily jeopardise the security and prosperity of every one concerned with a commercial enterprise.

The report was adopted.

NOTES FROM THE BRANCHES

WALES AND MONMOUTH BRANCH.—The November meeting took the form of a visit to the Glanmor Foundry, Llanelly, where, following a tour of the works, the members were addressed by Mr. S. L. Finch, of Letchworth, Herts, who reviewed the Paper entitled "The Gating and Feeding of Steel Castings," of which he is co-author with Mr. S. T. Jazwinski and Mr. E. D. Wells. The company were greeted upon arrival at the foundry by Mr. A. C. Whiteley, managing director, and Mr. Gordon Rees, works manager. They assembled first in the roll foundry, where they saw two large chilled rolls cast. Metal was tapped from the reverberatory furnace into a 15-ton ladle, the furnace being fired with pulverised coal. They then divided into convenient groups in order to visit each department under the care of a guide. Tea was served in the works canteen, following which Mr. Finch addressed the meeting, aided by a series of slides to illustrate his subject. The subsequent discussion showed that the lecture had been followed with great interest. A vote of thanks was accorded the lecturer on the proposition of Mr. Gordon Rees, seconded by Mr. Raymond Jones, to which Mr. Finch suitably replied.

Mr. R. J. Richardson, past-president of the branch, proposed, and Dr. Crow seconded, a vote of thanks to the directors of the Glanmor Foundry Company, for affording facilities for a most interesting visit, tea and lecture. Replying, Mr. Whiteley expressed the gratification of his directors and himself at so good an attendance in spite of many counter attractions on a Saturday afternoon. It was the first meeting of the branch in West Wales since pre-war days, and he hoped that the interest would be maintained. It was the wish of the members in the Llanelly and Swansea district to establish a section of the Wales and Monmouth branch in West Wales, and so enable them to arrange their own series of lectures. It was not always convenient to travel 50 or 60 miles to attend a meeting in Cardiff. He appreciated the effort of the Cardiff and Pontypridd people who had come down and contributed to the success of that meeting. They could rely upon him and his firm to support the aims of the Institute in that area, and he was confident that they were capable of running a section of the branch to the ultimate benefit of the industry in West Wales. The attendance, including about 60 from Cardiff and Pontypridd, was very little short of a hundred.

LONDON BRANCH.—A peace celebration dinner was held last Friday at Pimms Red House Restaurant, Bishopsgate. The branch president, Mr. A. J. Murphy, M.Sc., was in the chair. About 90 members and guests were present. In welcoming the guests, the chairman expressed the regret of the Council that conditions were not yet entirely suitable for returning to pre-war dimensions and that it had not been possible to include ladies. Thus it had been decided to make the event quite an informal function restricting invitations to the president of the Institute, the secretaries and Dr. D. H. Ingall, Principal of the Borough Polytechnic, who was so closely associated with the branch's educational activities. Mr. J. W. Gardom, the president of the Institute, who replied, voiced the general feeling of the members by paying a well-merited tribute to Mr. F. Arnold Wilson, the honorary secretary, for organising the function. The food was excellent, as was the entertainment which followed.

SLOUGH SECTION.—The monthly meeting on December 4, took the form of a visit to the foundries and laboratories of High Duty Alloys, Limited, tea in the works canteen, followed by the showing of "Light Alloy Castings," a film produced by High Duty Alloys, Limited, illustrating modern light alloy foundry technique and its scientific background. This was introduced by the vice-president, Mr. Ian Ross, through whose good office the visit was arranged.

IMPORTS AND EXPORTS OF IRON AND STEEL

BOARD OF TRADE RETURNS FOR NINE MONTHS OF 1945

Figures of Britain's overseas trade in the first nine months of 1945 are contained in returns just published by the Board of Trade. The following tables give the imports and exports of iron and steel and manufactures thereof. Three-quarters of the 1938 totals are shown in the first column for purposes of comparison.

Total Exports of Iron and Steel.

Destination	Three-quarters of year 1938	Nine months ended September 30	
		1944	1945
	Tons	Tons	Tons
Eire	41,785	11,757	18,586
Channel Islands	5,562	—	352
Palestine	6,055	2,167	8,960
British West Africa	37,305	6,001	13,757
Union of South Africa	173,306	14,096	44,680
Northern Rhodesia	15,430	4,877	2,401
Southern Rhodesia	27,157	7,701	10,862
British East Africa	19,446	2,152	6,251
British India	118,955	15,331	19,328
Burma	13,882	—	—
British Malaya	49,936	—	—
Ceylon	19,520	2,948	4,374
Hong Kong	17,694	—	—
Australia	128,125	2,835	4,120
New Zealand	98,908	5,427	6,461
Canada	64,046	414	2,464
British West India Islands	33,187	673	4,126
Anglo-Egyptian Sudan	6,218	1,400	2,460
Other British Countries	16,438	1,580	4,383
Soviet Union	3,262	5,130	2,005
Finland	13,178	—	—
Sweden	8,860	—	—
Norway	15,198	—	2,985
Iceland	493	384	2,477
Denmark	65,416	—	463
Germany	25,354	—	—
Netherlands	38,650	—	3,698
Dutch East Indies	20,475	—	—
Dutch West India Islands	1,848	265	1,563
Belgium	15,192	—	17,562
France	10,038	—	78,469
Portugal	5,781	926	7,142
Portuguese East Africa	10,665	139	444
Spain	5,822	351	1,549
Egypt	25,803	5,286	15,088
Iraq	19,305	1,517	10,523
Iran	82,785	38,759	37,022
China	16,597	344	360
Japan	5,216	—	—
United States of America	1,640	4,831	207
Brazil	12,742	73	1,595
Argentine Republic	59,512	118	2,178
Other Foreign Countries	79,615	4,200	18,171
Total	1,436,402	141,682	357,075

(*Continued in next column.*)

A MEETING TO BE HELD in Paris next spring will make arrangements for a sectional meeting of the World Power Conference in 1947, when consideration will be given to the general question of fuel economy. Sir Harold Hartley, F.R.S., is the chairman of this organisation.

(*Continued from previous column.*)

Total Imports of Iron and Steel.

From	Three-quarters of year 1938	Nine months ended September 30	
		1944	1945
	Tons	Tons	Tons
British India	116,725	129,119	84,803
Canada	88,030	87,700	43,467
Other British Countries	4,225	478	4,296
Sweden	67,346	11	6,614
Norway	25,331	—	27
Germany	72,257	—	—
Belgium	205,260	—	—
Luxemburg	43,951	—	—
France	193,010	—	—
United States of America	150,519	1,095,196	116,711
Other Foreign Countries	41,549	720	2,782
Total	1,008,203	1,313,224	258,700
Iron ore and concentrates—			
Manganiferous	46,712	—	—
Other sorts	3,826,400	1,603,548	3,003,891
Iron and steel, scrap and waste, fit only for the recovery of metal	474,152	10,495	111,409

Exports of Iron and Steel by Products.

Product	Three-quarters of year 1938	Nine months ended September 30	
		1944	1945
	Tons	Tons	Tons
Pig-iron	70,456	2,423	534
Ferro-alloys, etc.—			
Ferro-tungsten	388	16	64
Spiegeleisen and ferro-manganese	3,898	33	26,389
All other descriptions	786	229	688
Ingots, blooms, billets and slabs	7,307	119	326
Iron bars and rods	2,398	98	615
Sheet bars, tinplate bars, wire rods and bright steel bars	16,612	821	4,816
Other steel bars and rods	76,502	7,520	27,815
Special steel	3,700	1,852	2,483
Angles, shapes and sections	50,554	5,363	22,186
Castings and forgings	1,214	374	220
Girders, beams, joists and pillars	25,103	4,418	14,600
Hoop and strip	28,033	832	4,311
Plates ⅛ in. thick and over	98,219	11,257	50,000
Black plates	10,903	722	779
Black sheets	47,635	1,019	1,171
Galvanised sheets	110,200	585	1,031
Tinplates	239,481	8,366	15,131
Tinned sheets	1,058	484	570
Terneplates	3,244	2,218	3,286
Decorated tinplates	3,276	320	688
Cast-iron pipes up to 6 in.	36,696	1,142	5,709
Do., over 6 in.	32,222	2,272	4,822
Wrought iron tubes	164,980	33,194	43,002
Steel rails	79,500	15,812	36,732
Sleepers and fishplates	19,037	2,040	6,332
Other railway material	20,078	2,689	4,326
Wire	41,386	1,583	6,169
Wire manufactures	22,114	3,230	4,841
Nails, tacks, etc.	2,854	4,287	3,740
Rivets and washers	6,402	798	1,315
Wood screws	1,884	1,839	1,399
Bolts, nuts and metal screws	13,150	2,161	4,310
Stoves, grates, etc.	6,862	1,268	2,249
Sanitary cisterns	2,109	149	291
Fencing material	3,847	65	515
Anchors, etc.	8,967	1,594	4,198
Springs	2,948	414	800
Total, including all other manufactures of iron and steel	1,436,402	141,682	357,075

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NEWS IN BRIEF

A SCOTTISH BRANCH of the Institution of Engineering Inspection is to be formed.

THE FIRST OF THE three blast furnaces at Ijmuiden, in Holland, has been put into service again.

THE ROECHLING STEELWORKS, in the Saar basin, are now under French management and are expected to resume production at the rate of 10,000 tons per month.

ACCORDING TO AN official report, stocks of tin concentrates in Siam are over 16,000 tons and of tin metal about 4,000 tons. The state of the mines is believed to be not unsatisfactory and some dredges have been working.

MR. GEORGE BUCHANAN, M.P., Joint Parliamentary Under-Secretary of State for Scotland, addressed a representative meeting of employers and operatives of the light-castings industry in Glasgow last week. He said that in the next six or eight weeks there would be a considerable speed-up in the temporary housing programme in Scotland, and the light-castings industry would be called on to play a vital part.

TWO BRITISH METALLURGISTS were invited by the Société des Ingénieurs Civils de France to read Papers on metallurgical subjects in Paris on November 9. The first was on "Some Metallographic Work Accomplished in Great Britain During the War in Respect of Light Alloys," by J. L. Haughton, D.Sc., F.Inst.P., of the National Physical Laboratory, and the second on "Recent Progress in the British Iron and Steel Trades in Great Britain," by D. F. Campbell, M.A., A.R.S.M.

TWELVE BOYS from South Shields secondary schools have been selected for special training by James Shaffer, Limited, London, who are building a factory for making brass fittings and other equipment at South Shields. The boys will undergo special courses, the firm paying all fees and travelling expenses, and those who prove proficient will have the opportunity to obtain higher posts with the firm. Similar opportunities will be offered to other South Shields secondary schoolboys from time to time.

A DIVISION of responsibilities between the Board of Trade and the Ministries of Supply and Aircraft Production has recently taken place. Organisations and firms in the engineering industry which have hitherto looked to the Board of Trade for advice and assistance, in future should normally make their approaches to the Government on similar matters through the Ministry of Supply. The headquarters organisation concerned is the Engineering Industries Division, Ministry of Supply, I.C. House, Millbank, London, S.W.1.

MR. ERIC G. GARDNER, who is employed by Hadfields, Limited, East Hecla Works, Sheffield, received the 1944 Silver Medal of the City and Guilds of London Institute from Sir Peter B. Brown recently at the Applied Science Department of Sheffield University. This is the first time the medal has been won by a Sheffield man. It is awarded annually to the candidate who obtains highest marks in the final examination for patternmaking. Mr. Gardner also won, in 1943, the Bronze Medal of the Institute for top place in the intermediate examination.

OUR SCOTTISH REPORTER was ill-informed when he indicated that Glenfield & Kennedy, Limited, of Kilmarnock, were the pioneers among Scottish industrialists to provide baths for their workers. Already we have received well-authenticated protests from Wm. Cumming & Company, Limited, of Kelvinvale Mills, Maryhill, Glasgow, N.W., and G. & J. Weir, Limited, Cathcart, Glasgow, S.4. The latter has even gone a step farther, as in this case sun lamps were available before June, 1942. Moreover, we are prepared to learn that there may be other firms with similar facilities.

PRESIDING AT the annual meeting of the South African Iron & Steel Industrial Corporation, Limited, Dr. Van der Bijl advocated the complete removal of the controls on marketing of steel, although admitting the necessity of some rationing in view of the limited supplies from overseas. He claimed that present Witwatersrand "Iscor" prices were from £5 to £7 below American prices and £7 to £9 below British prices delivered there. Pre-war "Iscor" business was mainly on the Rand, but the war had brought an extension to the whole of the Union. Prices in some coast towns were now competitive. The haul which "Iscor" had to Cape Town proved more costly than ocean freights, hence imported steel was cheaper there, but at the moment scarcely obtainable.

WITH THE EXPRESSED INTENTION of securing a full exploitation of the many national advantages of the river, the Tees Conservancy Commission has deposited in Parliament a Bill proposing the broadening of the constitution of the authority so as to give representation to local authorities hitherto excluded, the purchase of the Middlesbrough L.N.E.R. Dock, the construction of a new deep-water dock nearer the mouth of the river on a site adjacent to that on which Dorman, Long & Company, Limited, propose to erect a new steel plant, the provision of oil and coal bunkering facilities, and the deepening of the river channel. The contemplated expenditure is believed to be in the region of £6,000,000, and if the Bill receives Parliamentary sanction the Tees Conservancy Commission will have all the necessary powers to raise the status of the Tees to that of a first-class port.

ALUMINIUM DEVELOPMENT ASSOCIATION

The president (the Hon. Geoffrey Cunliffe) and Council of the Aluminium Development Association held a reception at Claridges recently in order to introduce Air-Commodore W. Helmore, C.B.E., Ph.D., the newly appointed director-general, and to mark the establishment of the Association's new headquarters at 67, Brook Street, London, W.1. The appointment of director-general is an additional position and Dr. E. G. West, who was so long connected with the Wrought Light Alloys Development Association, continues as technical director.

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PERSONAL

MR. W. GOMERSALL has been appointed managing director of Joshua Hindle & Sons, Limited, brassfounders and engineers, Leeds.

VISCOUNT WEIR has been re-elected honorary president of the British Employers' Confederation. MR. ANDREW K. MCCOSH, chairman of Wm. Baird & Company, Limited, has been elected president.

MR. N. R. REECE, foundries general manager of the Staveley Coal & Iron Company, Limited, has left on a visit of inspection of the iron and steel industry of Germany, and expects to be away several weeks.

MR. C. F. BATSTONE has been appointed Midland branch manager of the British Aluminium Company, Limited. MR. E. V. PANNELL will be retiring at the end of the year after 34 years' service with the company.

MR. C. A. PEAKE has resigned his position with the Watford Foundry Company, Limited, and joined the staff of the Kingsworthy Foundry Company, Limited, Winchester. His new address is Selbourne Lodge, Worthy Road, Winchester, Hants.

MR. THOMAS MORISON, a director of Swan, Hunter & Wigham Richardson, Limited, Newcastle-upon-Tyne, has been elected president of the Shipbuilding Employers' Federation for the coming year, in succession to MR. J. RAMSAY GEBBIE, managing director of William Doxford & Sons, Limited, Sunderland.

SIR HENRY DALE, O.M., will retire from his position as Fullerian Professor of Chemistry in the Royal Institution and Director of the Davy-Faraday Research Laboratory on September 30, 1946. PROF. ERIC K. RIDEAL, Professor of Colloid Science in the University of Cambridge, is to be his successor in both posts.

MR. JAMES RAILTON, chairman of Stothert & Pitt, Limited, and Torrance & Sons, Limited, has resigned these positions as from December 31. He has occupied these offices since 1929. SIR LLEWELLYN T. G. SOULSBY has been appointed to succeed him. Mr. Railton announced his intention to resign at the recent annual meeting.

DR. D. S. ANDERSON, who for the past 15 years has been Principal of the Central Technical College, Birmingham, has been appointed Director of the Royal Technical College, Glasgow. Born in 1895, Mr. Anderson in 1920 graduated B.Sc. at Glasgow University, with special distinction in mechanical and electrical engineering, mathematics, and physics, and in 1921, he was granted the Associateship of the Royal Technical College, with special distinction in mechanical engineering. His industrial experience included a four-year apprenticeship with the North British Locomotive Company, Limited, Glasgow, and six months with Fullerton, Hodgart & Barclay, Limited, engineers and ironfounders, Paisley. From 1920 until 1924 he was engaged solely on engineering research at the Royal Technical College. In 1924 he graduated Ph.D. in the Faculty of Engineering of Glasgow University, and in the same year was appointed head of the department of Mechanical and Civil Engineering at the Derby Technical College. He took up his appointment as Principal of the Central Technical College, Birmingham, in January, 1930.

Wills

PEACE, N. K., of Wolverhampton, iron and steel merchant £18,277

MANTLE, J. D., of Groby, Leicestershire, chairman of A. A. Jones & Shipman, Limited £90,122

LATBE, C. E., of Wolverhampton, managing director, of C. Latbe & Company, Limited, grate manufacturers, Tipton £48,209

SUBSCRIPTIONS TO TECHNICAL INSTITUTIONS

An attempt was made during the discussion of the Finance Bill in its committee stage to exempt from income tax any subscriptions paid to institutions or other such bodies conducted wholly for the advancement of learning, science or technology.

Moving a new clause to this effect, COL. ERROLL said that membership of a learned or professional society was essential to the professional man, particularly to a technical man. Many Government departments insisted on membership of certain technical institutions as a necessary condition of Government appointment. The justice of the proposition was to a large extent already admitted by the Treasury, since a certain small concession already existed. The concession was that where membership was made a condition of employment the tax should be remitted, but where it was not made a condition of employment, or where a man was independent, such as a consulting engineer, he must pay the subscription out of his taxed income. He hoped the Treasury would now go all the way.

SIR WAVELL WAKEFIELD said the clause would help young men starting on their scientific careers and to whom subscriptions which might amount to £10 or £15 meant a real burden.

MR. LINSTEAD said that the independent practitioner of engineering, chemistry or other professions was entitled to deduct subscriptions which he paid to scientific societies in so far as they were necessary to the practice of his profession. A man with identically similar qualifications who happened to be an employee was prejudiced. He was not allowed to deduct the same subscriptions as his employer.

THE SOLICITOR GENERAL, Sir Frank Soskice, resisted the clause, which was negatived.

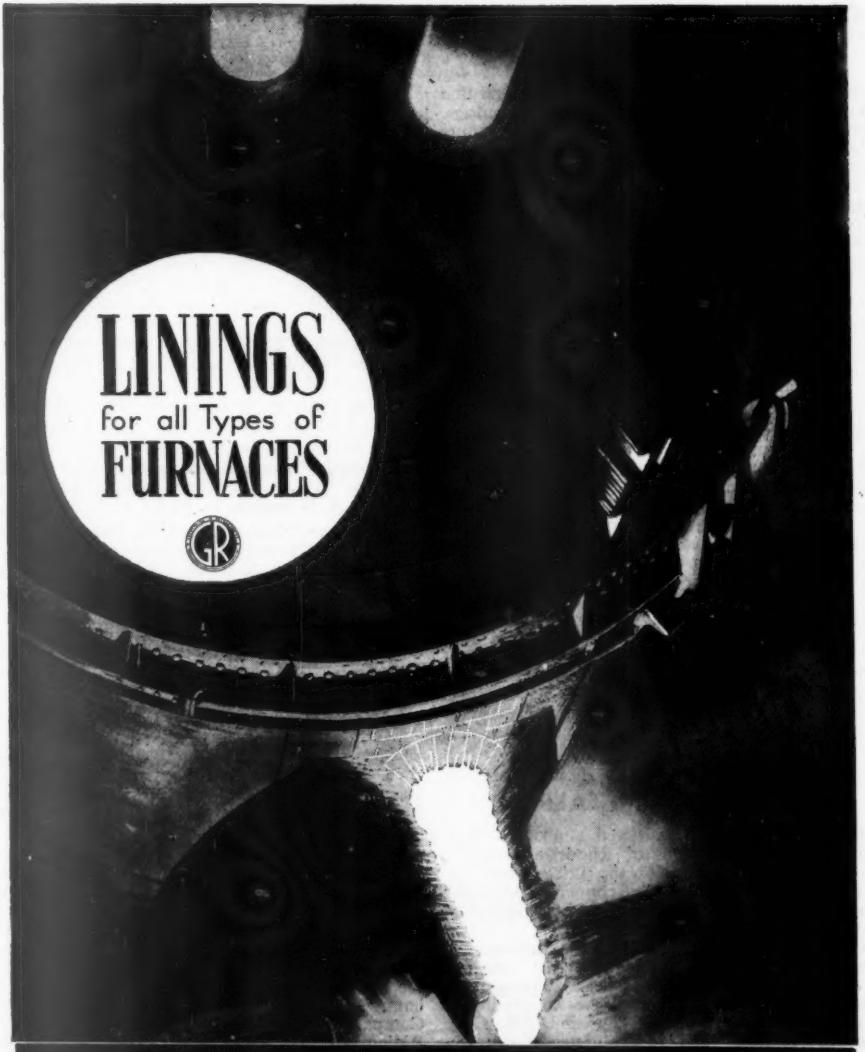
CASTINGS FOR HOUSES

In the House of Commons, last week, COL. ERROLL asked the Minister of Supply and of Aircraft Production from what sources he expected to obtain such castings as were needed for the State manufacture of housing components.

MR. WILMOT: These requirements will be obtained from the foundry industry.

COL. ERROLL: Is the Minister satisfied that foundries can supply the castings for the purpose?

MR. WILMOT: Yes, sir, I think so.



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Raw Material Markets

IRON AND STEEL

The speed-up in demobilisation promises a welcome accession of labour at the furnaces and the foundries. For both, the industrial outlook is entirely favourable. Light-castings foundries are likely to be busy for years ahead on domestic fittings, and the position at the engineering foundries has recently registered some improvement. Hence the output of most grades of pig-iron is fully absorbed. High-phosphorus iron is scarcer than other grades, and though none of the foundries has yet been seriously inconvenienced, the reserves have been reduced to such small proportions that an expansion of foundry iron production is becoming imperative. Hematite is now more abundant and there is less interest in refined iron.

The distribution of steel semis imported from Canada and Australia has relieved the sharper apprehensions of re-rollers, who had begun to fear that a shortage of supplies would impede operations at the finishing mills. The demand, however, for both sheet-bars and square and flat billets is still very keen and the market for defective material is brisk.

For most descriptions of finished steel it is now a question of securing reasonable delivery dates. Periods three or more months ahead are commonly indicated and works will be fully engaged to the end of the year in executing contracts due for completion within the period. Heavy structural steels are in limited demand for home use, but for these as well as for light sections and steel plates there are abundant export inquiries from Western Europe, South Africa and the Far East. The sheet mills cannot cope with all the business on offer. Buyers are warned that the waiting period for black sheets may be six months, and for galvanised sheets even longer, though quicker delivery is offered for heavy gauge sheets and medium plates.

NON-FERROUS METALS

Imports of copper remain restricted almost entirely to Rhodesian ore. Some sales of Rhodesian copper have now been made for 1946, the price basis remaining unchanged. Total stocks of copper in America are estimated at 850,000 tons. This amount includes both Government and industrial stocks.

Imports of tin ore into this country during the first nine months of 1945, totalled 35,310 tons, a progressive increase on the previous year. The supply of lead is still below the demand. The international supply system is in a precarious position following the strikes in Australia, and is likely to deteriorate.

Supplies of raw zinc are maintained satisfactorily. An increasing possibility is that the world price of zinc, at the moment higher than in this country, may ease. A large decrease in imports of raw aluminium into this country has been recorded for the first nine months of the year, the total being 9,040 tons, against 122,363 tons in the corresponding period of 1944.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

M. H. Hurst Engineering (Coventry), 90, Anchorway Road, Coventry—£1,000.

B.V.C. Industrial Constructions, 3, Gt. Winchester Street, London, E.C.2—£20,000.

H. J. Fuller & Sons, 91, Meadow Lane, Leeds, 11—Engineers. £5,000. F. H. and W. E. Fuller.

Associated British Oil Engines, 27, Gilbert Street, London, W.1—£100. A. P. Good and F. S. Mitman.

A. C. Giles & Company, 128, Beckwith Street, Birkenhead—General and mechanical engineers, etc. £2,000.

L. Whiting, 22, Cromwell Mews, South Kensington, London, S.W.7—Metal merchants, etc. £1,000. L. Whiting and W. E. Glover.

Mace Engineering Company (Liverpool), 4a, Orwell Road, Liverpool, 20—£1,000. H. A. Mace, J. Green, E. Q. Read, and F. Davidson.

Douglas Gruban Equipments, 14, Parson Street, London, N.W.4—Machinery and metal merchants, etc. £1,000. J. D. and A. A. E. Gruban.

Blake Vitreous Enamelling, Oakenshaw Works, Clayton le Moors, Accrington—£20,000. H. A. and A. P. Blake and A. C. D. Coombes.

Almin, 101, Cannon Street, London, E.C.4—To promote the production of metals of every description, including in particular aluminium and magnesium, etc. £100. L. F. A. D'Erlanger, P. Horstall, W. C. Devereux, and S. Sanders.

OBITUARY

MR. CHARLES TAGGART, governing director of Charles Taggart, Limited, agricultural engineers, Aberdeen, has died at the age of 70. Recognised as an expert on the internal combustion engine from its earliest days, he was a past-president of Aberdeen Mechanical Society.

MR. GEORGE PETER RAUNDRUP, a well-known figure in the pig-iron trade of the North-west, died at his home at West Didsbury, Manchester, on November 30, at the age of 75. Until his retirement in September of last year, Mr. Raundrup had been connected for 44 years with the Staveley Coal & Iron Company, Limited, Chesterfield, and for about 20 years with the Park Gate Iron & Steel Company, Limited, Rotherham. He was pig-iron sales manager for the Staveley Company for the Lancashire, Cheshire, and West Riding of Yorkshire areas, and Lancashire and Cheshire representative of the Park Gate Company. For 47 years he had regularly attended the iron and steel markets on the Manchester Royal Exchange and had a wide circle of friends in the trade. Mr. Raundrup represented the Staveley Company on the Central Pig-iron Producers' Association from its formation in 1929 until the time of his retirement.